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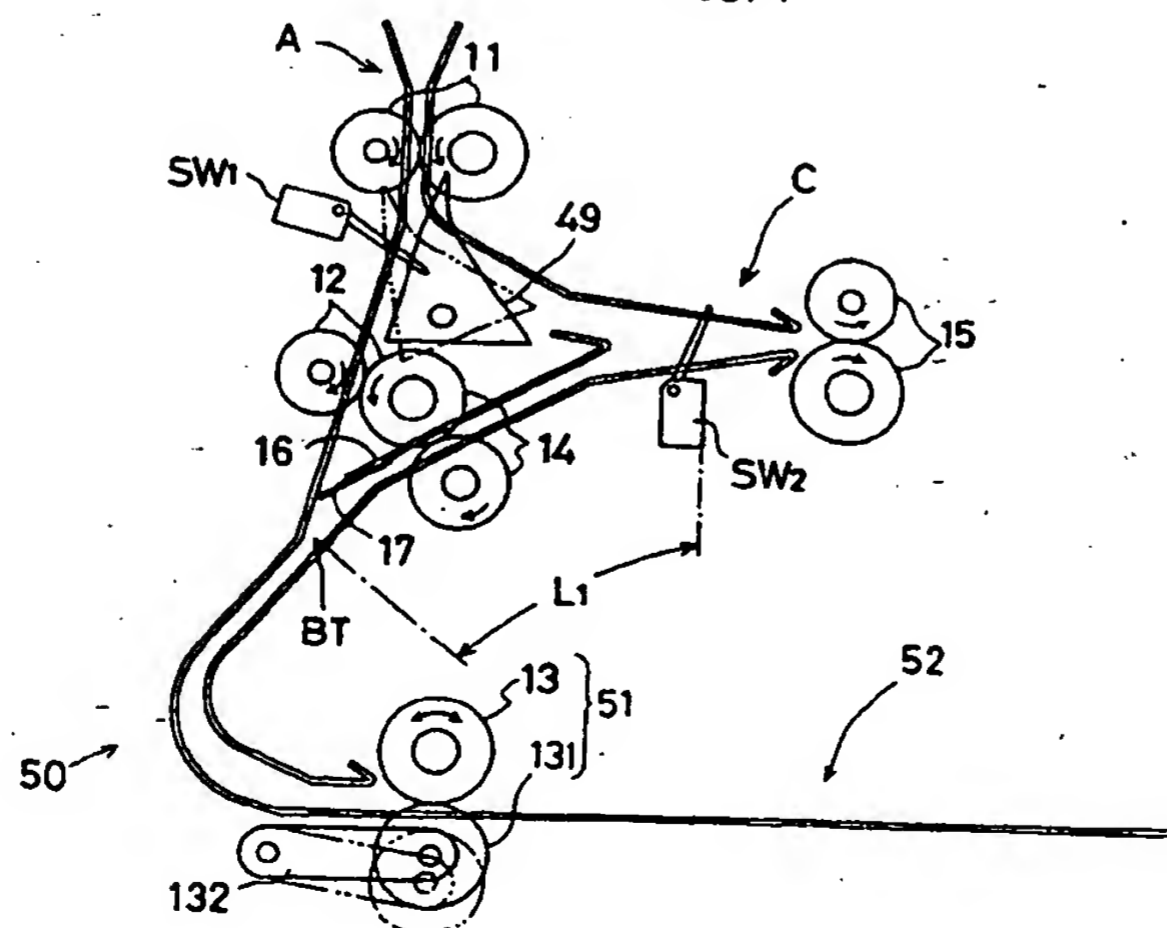
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(54) **A sheet inverting device.**

(57) A sheet inverting device is provided with a sheet transport path including an upstream path including a first roller pair (11), a downstream path including a second roller pair (15), and an inverting path arranged between the upstream and downstream path. Along the inverting path is arranged a reversing means including a reversing roller (13) rotatable reciprocally and a contact member (131) movable between a contact position where it is in contact with the reversing roller and a spaced position where it is

away from the reversing roller. The reversing roller is driven in a forward direction while the sheet is transported from the inverting path to the downstream roller pair. The contact member is held in the spaced position while a monitor device for monitoring the position of the sheet being transported detects that preceding and following sheets being transported overlap each other at the position of the reversing roller.

FIG. 1



## BACKGROUND OF THE INVENTION AND RELATED ART STATEMENT

This invention relates to a sheet inverting device which is used when a duplex copy is made in an image forming apparatus and is adapted for inverting and refeeding a sheet such as a copy sheet and, particularly to a sheet inverting device provided with a sheet transport path including in an intermediate portion thereof an inverting path where transport of the sheet is reversed.

Image forming apparatuses are in general provided with a function of making duplex copies from duplex documents or from simplex documents as one of image forming functions. A basic duplex copying operation is described briefly below. A sheet such as a copy sheet is fed to an imaging assembly in which an image of one document is formed on a front face of the sheet, and then has its transport reversed in a sheet inverting device so as to invert the sheet. The sheet is re-fed to the imaging assembly in this state, and an image of a next document is formed on a rear face of the sheet.

Figs. 12 to 15 are diagrams showing how the sheet is inverted along the sheet transport path in the sheet inverting device of prior art. Pairs of rollers 11, 12, 14, 15 and a pair of reversing rollers 13 are constantly rotated while the sheet is transported. The reversing rollers 13 are rotatable reciprocally.

Fig. 12 shows a state where a sheet P1 is transported from an upstream path A. When a leading edge of the first sheet P1 is transported up to a switch SW1 by the rollers 11, the reversing rollers 13 are started rotating in the forward direction.

Fig. 13 shows a state where a trailing edge of the sheet P1 has reached the switch SW1. When a trailing edge of the sheet P1 reaches the switch SW1 while the sheet P1 is carried into an inverting path B by the rollers 11, 12 and the reversing rollers 13 from the state shown in Fig. 12, a timer is started by an unillustrated control unit so as to measure a specified period T1.

Fig. 14 shows a state where the sheet P1 is completely carried into the inverting path B. Upon lapse of the period T1 from the state shown in Fig. 13, it is determined that the sheet P1 is completely carried into the inverting path B. Thereupon, the reversing rollers 13 have rotation thereof reversed, and the sheet P1 is carried out of the inverting path B to a downstream path C.

Fig. 15 shows a state where the sheet P1 is completely carried out of the inverting path B to the downstream path C. When the trailing edge of the sheet P1 passes a junction BT where the inverting path B is connected to the upstream and

downstream paths A and C, or reaches a switch SW2, a leading edge of a next sheet P2 reaches the switch SW1. Thereupon, the reversing rollers 13 have rotation thereof reversed so as to rotate in the forward direction as shown in Fig. 12. In this way, the sheets P transported one after another from the upstream path A are sequentially inverted in the inverting path B and fed to the downstream path C.

The sheet inverting device of the prior art is constructed such that the next sheet P2 is carried into the inverting path B from the upstream path A by changing the rotation of the reversing rollers 13 to the forward rotation after the sheet P1 is carried out of the inverting path B completely. This construction requires large intervals between two consecutive sheets being transported, thereby presenting the problem of slowing the copying rate. More specifically, let it be assumed that the length of the sheet to be transported is  $L_a$ , and the distance between the switch SW1 and the pair of reversing rollers 13 is  $L_2$ . In order to transport the sheets P1, P2 one after the other without causing the sheets to overlap each other along the transport path at all, the following sheet P2 should be spaced apart from the leading sheet P1 at least by a distance which is a sum of twice the length of the sheet  $L_a$  (the length of transport back and forth of the sheet in the inverting path B) and the length  $L_2$ .

## SUMMARY OF THE INVENTION

It is an object of the invention to provide a sheet inverting device which has overcome the problem residing in the prior art and enables transport of consecutive sheets in a state where one sheet is lying over another along an inverting path.

It is another object of the invention to provide a sheet inverting device which is capable of transporting sheets along a transport path at a reduced interval by transporting the consecutive sheets in the state where one sheet is lying over another to increase the sheet transport speed as a whole.

Accordingly, the invention is directed to a sheet inverting device for inverting sheets transported one after another from an upstream path having a first roller pair and transporting the inverted sheets toward a downstream path having a second roller pair, the sheet inverting device comprising, inverting path means provided between the upstream path and the downstream path and provided with reversing means, the reversing means including a reversing roller rotatable in opposite directions, a contact member movable between a contact position where it is in contact with the reversing roller and a spaced position where it is away from the reversing roller, and the reversing means being adapted for carrying the sheets into

the inverting path means and transporting the sheets from the inverting path means to the second roller pair, the first roller pair arranged along the upstream path and adapted for transporting the sheets from an upstream side to the reversing means, rotation control means for controlling the reversing roller to rotate in a forward direction at least until each sheet is transported to the second roller pair from the inverting path means, monitor means for monitoring the positions of the sheets being transported, and control means for holding the contact member in the spaced position at least while the monitor means detects that a preceding sheet and a following sheet being transported overlap each other at the position of the reversing roller.

These and other objects, features and advantages of the present invention will become more apparent upon a reading of the following detailed description and accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

- Fig. 1 is a diagram showing a detailed construction of a sheet inverting device;  
 Fig. 2 is a block diagram showing a control system for controlling respective components of the sheet inverting device;  
 Fig. 3 is a diagram showing an entire construction of an image forming apparatus incorporating a sheet inverting device according to the invention;  
 Fig. 4 is a diagram showing a state where a copy sheet P1 is transported from an upstream path A;  
 Fig. 5 is a diagram showing a state where a trailing edge of the copy sheet P1 has reached a switch SW1;  
 Fig. 6 is a diagram showing a state where transport of the copy sheet from an inverting path 52 is started;  
 Fig. 7 is a diagram showing a state where a leading edge of the copy sheet P1 has reached a switch SW2;  
 Fig. 8 is a diagram showing a state where the copy sheet P1 and a following copy sheet P2 are transported in opposite directions with one over the other in the inverting path 52;  
 Fig. 9 is a diagram showing a state where a trailing edge of the copy sheet P2 has reached the switch SW1;  
 Fig. 10 is a flow chart showing a sheet transport operation in the sheet inverting device;  
 Fig. 11 is a flow chart showing another sheet transport operation in the sheet inverting device;  
 Fig. 12 is a diagram showing a state where a sheet P1 is transported from an upstream path A in a sheet inverting device of prior art;

Fig. 13 is a diagram showing a state where a trailing edge of the sheet P1 has reached the switch SW1 in the sheet inverting device of the prior art;

Fig. 14 is a diagram showing a state where the sheet P1 is carried into an inverting path in the sheet inverting device of the prior art; and

Fig. 15 is a diagram showing a state where the sheet P1 is completely transported to a downstream path C in the sheet inverting device of the prior art.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Fig. 3 is a diagram showing an entire construction of an image forming apparatus 20 incorporating a sheet inverting device according to the invention.

The apparatus 20 is provided with an automatic document feeder (ADF) 21, an optical system L, an imaging assembly G, and a transport assembly S.

The ADF 21 includes a document setting portion 211, a feed roller 212, a transport belt 213, a discharge roller 214, a discharge guide 215, and a discharge tray 216. Documents D set on the document setting portion 211 are transported one by one by the feed roller 212 and the transport belt 213 up to a specified position on a document platen 22 where transport of the documents is temporarily stopped. Thereafter, upon completion of reading of a document image, the documents D are discharged onto the discharge tray 216 through the discharge guide 215 by the transport belt 213 and the discharge roller 214.

The optical system L is provided with a reciprocally movable light source 24 including a halogen lamp 23 and a reflecting mirror 23R, reflecting mirrors 25a, 25b, and 25c, a lens unit 26, and an image reading unit 27 including a CCD and the like. A scanning beam emitted from the light source 24 is reflected by the document D staying at the specified position on the document platen 22, and is introduced to the image reading unit 27 by way of the reflecting mirrors 25a, 25b, 25c and the lens unit 26. In the image reading unit 27, the document image is read and stored as a document image signal in an unillustrated image memory.

The imaging assembly G is provided with a laser emitting device 28, a polygonal mirror 29a, fixed mirrors 29b, 29c, a lens array 30, a photosensitive drum 31, a main charger 32, a blank lamp 33, developing devices 34, 35 containing different colored toners therein for multi-color copying, a transfer charger 36, a separator charger 37 and a cleaner 38. The laser emitting device 28 emits a laser beam obtained by optically modulating the document image signal read from the image memory.

This laser beam is projected onto the surface of the photosensitive drum 31 charged uniformly by the main charger 32 by way of the polygonal mirror 29a, the fixed mirrors 29b, 29c, and the lens array 30. The surface of the drum 31 is exposed, and thereby an electrostatic latent image is formed thereon. The electrostatic latent image is developed by the developing devices 34, 35. The developed image is transferred to a fed copy sheet by the transfer charger 36, which is then separated from the surface of the drum 31 by the separator charger 37.

The transport assembly S is provided with cassettes 390, 391, a manual insertion guide 392, feed rollers 393, 394, pairs of registration rollers 395, 396, and 44 arranged in this order with respect to a sheet feeding direction upstream of the transfer charger 36. The transport assembly S is further provided with a transport belt 45, a fixing device 46, a refeeding mechanism Q, and a pair of discharge rollers 47 arranged in this order with respect to the sheet feeding direction downstream of the transfer charger 36. The copy sheet is fed from the cassette 390 or the like to the transfer charger 36 to have the developed image transferred there to. The image is then fixed onto the copy sheet by the fixing device 46. Consequently, the copy sheet bearing the image is discharged onto a discharge tray 57 or fed to the refeeding mechanism Q for duplex copying or other purposes.

The refeeding mechanism Q is adapted for refeeding the copy sheet bearing the image on one side face thereof to the registration rollers 44 so that another image is formed on the other side face of the copy sheet or on the same side face in a composite manner. The refeeding mechanism Q is provided with a sheet inverting device 50 including switch claws 48, 49, a pair of reversing rollers 51, and an inverting path 52, an intermediate tray 53, a forwarding roller 54, a forwarding belt 55, and a pair of refeeding rollers 56. The switch claw 48 allows the copy sheet to be refeed when it is turned upward in the drawing of Fig. 3. The switch claw 49 is turned right when a duplex copy is made, while being turned left when a composite copy is made. A detailed construction of the sheet inverting device 50 and peripheral devices thereof will be described with reference to Fig. 1.

When a duplex copy mode is selected, the copy sheet bearing the document image on a front face thereof is transported to the sheet inverting device 50 by way of the switch claws 48, 49. The copy sheet is transported to the inverting path 52 once by the forward rotation of the reversing roller pair 51. Thereafter, the copy sheet is carried out of the inverting path 52 by the reverse rotation of the reversing roller pair 51, and is fed to the intermediate tray 53 located at a downstream side to be

temporarily placed thereon. Then, the copy sheet placed in the intermediate tray 53 is transported to the registration rollers 44 by the forwarding roller 54, the forwarding belt 55 and the refeeding rollers 56. Transport of the copy sheet is paused at the registration rollers 44 so as to wait for a next image transfer. As timed with the next image transfer, the copy sheet is fed to the transfer charger 36 with a rear face thereof faced upward. Upon completion of the image transfer to the rear face, the copy sheet has the image fixed thereto by the fixing device 46, and is discharged onto the discharge tray 57 through the discharge rollers 47.

Fig. 1 is a diagram showing a detailed construction of the sheet inverting device 50.

In this figure, indicated at 11 are a pair of rollers which are arranged along an upstream path A of the sheet inverting device 50 and are adapted for transporting the copy sheets from the switch claw 48. The switch claw 49 is in a first position indicated by solid line in Fig. 1 when the duplex copy mode is selected, while being in a second position indicated by phantom line when the composite copy mode is selected. When the claw 49 is in the first position, the copy sheet transported by the rollers 11 is further transported to the inverting path 52 by way of a pair of rollers 12. A switch SW1 is arranged in a specified position between the rollers 11 and 12, and detects the copy sheet passing the rollers 12.

The reversing roller pair 51 shown in Fig. 3 includes a driving roller 13 and a driven roller 131. The driven roller 131 is connected to a pivotal arm 132, and is movable toward and away from the driving roller 13 according to the pivoting movement of the arm 132. The roller 131 is caused to move between a contact position where the roller 131 is in contact with the roller 13 (indicated by solid line in Fig. 1) and a spaced position where the roller 131 is spaced away from the roller 13 (indicated by phantom line in Fig. 1) by means of a third drive device 6 (see Fig. 2) such as a well-known solenoid. The roller 13 is drivingly rotated in the forward direction by a second drive device 5 (see Fig. 2).

The driven roller 131 serves as a contact member. It should be noted that in the invention, the contact member is not limited in a driven roller. For example, it may be possible to use a pivotably driven lever having a contact surface on a free end thereof, the contact surface being to come into contact with the driving roller 13 when held in its contact position.

Indicated at 14 are a pair of rollers for transporting the copy sheet in the inverting path 52 to a downstream path C. A single drive roller serves as a drive roller of the roller pair 12 and as a drive roller of the roller pair 14. Indicated at 15 is another

pair of rollers arranged along the downstream path C and adapted for conveying the copy sheet to the intermediate tray 53. A switch SW2 is arranged between the rollers 14 and 15, and detects the copy sheet passing the rollers 14. Indicated at 16 is a guide piece constituting a part of the downstream path C. The guide piece 16 is spaced apart from an outer (lower, in Fig. 1) guide member by a specified distance so as to define a passage therebetween. Indicated at 17 is an elastic guide provided at an upstream end of the guide piece 16 where the upstream path A and the downstream path C intersect, i.e. at a junction BT of the inverting path 52 for regulating a transport direction of the copy sheet. The elastic guide 17 contributes to more reliable transport of the copy sheet from the upstream path A to the inverting path 52, and from the inverting path 52 to the downstream path C.

The positional relationship between the rollers 12, 14 and the reversing rollers 51 is not limited to the one shown in Fig. 1. These rollers can be arranged in various preferable positions relative to the junction BT in consideration of the construction of the sheet inverting device 50 or the like. For instance, the distance between the rollers 12 and the junction BT may be different from the distance between the rollers 14 and the junction BT. Further, the reversing roller 51 may be arranged in proximity to the junction BT, or may be arranged at a further downstream side of the inverting path 52.

Fig. 2 is a block diagram showing a control system for controlling respective components of the sheet inverting device 50.

Indicated at 1 is a microcomputer for discriminating states and operated contents of the switches, and sending necessary command signals to specified circuits. The microcomputer 1 is provided with a rotation controller 8, drive controller 9 and a timer 10. Indicated at 2 is a copy switch for instructing a start of a copying operation and at 3 a duplex copy mode selection key for selecting the duplex copy mode. The switches SW1, SW2 are adapted for detecting the copy sheet as described above. With the use of the switches SW1, SW2, the timer 10 and the microcomputer 1, the position of the copy sheet being transported is monitored.

When the duplex copy mode is selected, the copy sheets are transported one after another at intervals of at least a sum of the length La of the copy sheet and the distance L1 between the junction BT of the inverting path 52 and the switch SW2. Such an interval (continuous transport interval) is set in advance. If this interval is set according to the greatest length of the usable copy sheets, the copy sheets can be transported one after another at fixed intervals regardless of the size of the copy sheets, thereby simplifying control for transport of the sheets.

Indicated at 4 is a first drive device for driving the feed rollers 393, the registration rollers 44, the transport belt 45, the discharge rollers 47, and other transport means in specified directions. Indicated at 5 is a second drive device for driving the roller 13 to rotate reciprocally in accordance with a signal from the rotation controller 8. Indicated at 6 is a third drive device for driving the pivotal arm 132 so as to move the driven roller 131 toward or away from the roller 13 in accordance with a signal from the drive controller 9. Indicated at 7 is a fourth drive device for driving other pairs of rollers 11, 12, 14, and 15.

Next, there will be described a sheet transport operation in the sheet inverting device 50 with reference to Figs. 4 to 9 and a flow chart shown in Fig. 10.

It will be appreciated that the copy sheet moving ahead is referred to as a copy sheet P1 while the copy sheet following the copy sheet P1 is referred to as a copy sheet P2 hereafter.

When the copy switch 2 is turned on in the duplex copy mode, the feed of the copy sheet is started. Then, the driven roller 131 is moved to the spaced position as shown in Fig. 4, and the roller 13 is driven in the forward direction in Step S1. In this state, the copy sheet P1 from the upstream path A is transported to the inverting path 52 by the rollers 11, 12. During this time, the copy sheet P1 passes over the switch SW1, which is kept in the ON state while the sheet P1 is passing thereover (YES in Step S2).

Upon arrival of the trailing edge of the copy sheet P1 at the switch SW1 as shown in Fig. 5, the switch SW1 is turned off (YES in Step S3). Thereupon, the driven roller 131 is moved to the contact position as shown in Fig. 5 and the timer 10 is reset ( $T = 0$ ) in Step S4. Then, the timer 10 starts a counting operation in Step S5. When the time T of the timer 10 reaches a predetermined time T1 (YES in Step S6), it is determined that the trailing edge of the copy sheet P1 has reached the junction BT of the inverting path 52 as shown in Fig. 6, and rotation of the roller 13 is changed from the forward rotation to the reverse rotation in Step S7. By driving the roller 13 in the reverse direction, there is started transport of the copy sheet P1 in the inverting path 52 toward the downstream path C. When the switch SW2 is turned on (YES in Step S8) upon arrival of the leading edge of the copy sheet P1 at the switch SW2 as shown in Fig. 7, it is discriminated whether the copying operation has been completed in Step S9. This discrimination is made by a CPU provided in the image forming apparatus for controlling an image forming operation or the like. This discrimination may be made based on the detection result of the switch SW1 in the case where the next copy sheet P2 is detected

by the switch SW1.

If the next copy sheet is being transported (NO in Step S9), this routine returns to Step S1 in which the driven roller 131 is moved to the spaced position as shown in Fig. 7 and the roller 13 is driven in the forward direction. Accordingly, the copy sheets P1, P2 are transported overlapping each other in the inverting path 52 in the opposite directions as shown in Fig. 8. When the trailing edge of the next copy sheet P2 reaches the switch SW1 as shown in Fig. 9, thereby turning off the switch SW1 (YES in Step S3), the driven roller 131 is moved to the contact position and the timer 10 is reset in Step S4 as described above. In this way, the above sequence of operations are repeated while the copy sheets are transported one after another. When the copying operation is completed, i.e. no more copy sheet is transported (YES in Step S9), the drive control by means of the microcomputer 1 is completed.

In this embodiment, the arrangement is such that the driven roller 131 is moved to the contact position in Step S4 when the trailing edge of the next copy sheet P2 is detected by the switch SW1 (YES in Step S3). However, the copy sheet is spaced apart from the preceding copy sheet at least by a distance which is a sum of the length of the copy sheet La and the distance L1 (see Fig. 1) between the junction BT of the inverting path 52 and the switch SW2. Accordingly, it may be appropriate to bring the driven roller 131 into contact with the roller 13 when the trailing edge of the copy sheet P1 is detected by the switch SW2 depending upon the positions of the rollers 12, 14 relative to the reversing roller pair 51. The driven roller 131 may be moved to the contact position in the following manner. A passing time required for the copy sheet P1 to pass the switch SW1 is measured. When the copy sheet P1 is transported from the inverting path 52, a time is measured in synchronism with the start of the reverse rotation of the roller 13. The driven roller 131 is moved to the contact position when the timer measures the passing time. By adopting any of the above arrangements, the driven roller 131 is brought into contact with the roller 13 at least after the copy sheet P1 is completely carried out of the inverting path 52.

Further in this embodiment, the position and the state of the copy sheets being transported are confirmed with the use of the switches SW1, SW2. However, there is a fixed positional relationship between the roller pairs 11, 12, 14, 15, the reversing roller pair 51 (the rollers 13 and 131), and the inverting path 52. Accordingly, if the positions of these rollers and path or the distances between them, and a transport speed are input to the microcomputer 1, a transport time can be calculated based on the transport speed and the distance

data. If the microcomputer 1 causes the timer 10 to measure the calculated transport time, the operations of the rollers 13 and 131 can be controlled by the timer 10 in place of the switches SW1 and SW2.

Fig. 11 is a flow chart showing another sheet transport operation.

It should be understood that unillustrated monitor devices are provided in the microcomputer 1 for monitoring the positions of the copy sheets P1, P2 being transported with respect to passage of time based on the timer 10 or the switches SW1, SW2. In view of the construction shown in Fig. 1, it is assumed that the leading edge of the copy sheet P1 transported from the inverting path 52 reaches the roller pair 14 earlier than the leading edge of the copy sheet P2 transported there into reaches the reversing roller pair 51.

When the copy switch 2 is turned on in the duplex copy mode, the feed of the copy sheet is started. Then, it is discriminated whether the leading edge of the copy sheet P2 transported from the upstream path A has reached the junction BT of the inverting path 52 in Step S11. Upon arrival of the leading edge of the copy sheet P2 at the junction BT (YES in Step S11), the driven roller 131 is moved to the spaced position in Step S12. At this time, the trailing edge of the copy sheet P1 transported from the inverting path 52 by the rollers 14 is passing the position of the roller 13 rotating in the reverse direction. However, since the driven roller 131 is spaced away from the roller 13, the copy sheets P1, P2 are transported from and into the inverting path 52 smoothly without being subjected to the force given from the roller 13 even through they are overlapping each other at the position of the roller 13.

In this state, it is discriminated whether the trailing edge of the copy sheet P1 carried out of the inverting path 52 has passed the position of the roller 13 in Step S13. When the trailing edge of the copy sheet P1 passes the position of the roller 13 (YES in Step S13), the driven roller 131 is moved to the contact position and the roller 13 is driven in the forward direction in Step S14. Thereupon, the copy sheet P2 transported by the rollers 12 is carried into the inverting path 52 smoothly by the rollers 13 and 131. When the trailing edge of the copy sheet P1 carried out of the inverting path 52 reaches the junction BT (YES in Step S15), the roller 13 is driven in the reverse direction so as to transport the copy sheet P1 to the downstream path C in Step S16.

Subsequently, it is discriminated whether the copying operation has been completed in Step S17. If the copying operation has been completed, this routine ends. On the other hand, if the copying operation is continued, i.e. a next copy sheet is

transported, this routine returns to Step S1 to repeat the similar operation.

To summarize, according to the invention, the pair of reversing rollers 51 (rollers 13, 131) are controlled in accordance with the detection signals from the switches SW1, SW2 serving as means for monitoring the positions of sheets being transported. Specifically, the roller 13 is driven in the reverse direction so as to carry the preceding sheet P1 out of the inverting path 52. On the other hand, the roller 13 is driven in the forward direction so as to carry the following sheet P2 coming from the roller pair 12 into the inverting path 52. Further, the driven roller 131 is held in the spaced position away from the roller 13 at least while the preceding sheet P1 transported to the downstream path C by the rollers 14 and the following sheet P2 carried into the inverting path 52 by the rollers 12 overlap each other at the position of the roller 13. Accordingly, the interval between two consecutively transported copy sheets is not required to be greater than a sum of the length of the copy sheets and the distance between the junction BT and the rollers 14 by suitably adjusting the positions of the roller pairs 12, 14 and the reversing roller pair 51 relative to the junction BT. It is sufficient that the leading edge of the preceding copy sheet P1 reaches the roller pair 14 earlier than the leading edge of the following copy sheet P2 reaches the reversing roller pair 51.

The roller 13 and the driven roller 131 may be controlled not according to the positional relationship between the preceding and following copy sheets, but according to a transported state of one copy sheet. Specifically, the roller 13 is driven in the forward direction and the driven roller 131 is moved to the contact position immediately before the leading edge of the sheet carried into the inverting path 52 from the roller pair 12 reaches the roller 13. Further, the roller 13 is driven in the reverse direction at least after it is detected that the trailing edge of this sheet carried out of the inverting path 52 has passed the junction BT. The driven roller 131 is moved to the spaced position at least after it is detected that the trailing edge of the sheet carried out of the inverting path 52 has passed the roller 13.

Further, in the foregoing embodiments, the invention is applied to an image forming apparatus in which copy sheets are transported. However, the invention is also generally applicable to any inverting device for inverting sheet materials other than copy sheets.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art. Therefore, unless other-

wise such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.

## Claims

1. A sheet inverting device (50) for inverting sheets (P,P1, P2) transported one after another from an upstream path (A) having at least a first roller pair (11) and for transporting the inverted sheets toward a downstream path (C) having at least a second roller pair (15), the sheet inverting device (50) comprising:

inverting path means (52) provided between the upstream path (A) and the downstream path (C) and provided with reversing means (51), the reversing means (51) including:

a reversing roller (13) rotatable in opposite directions;

a contact member (131) movable between a contact position where it is in contact with the reversing roller (13) and a spaced position where it is away from the reversing roller (13); and

2. A sheet inverting device according to claim 1, wherein the reversing means (51) being adapted for carrying the sheets (P,P1,P2) into the inverting path means (52) and transporting the sheets (P,P1,P2) from the inverting path means (52) to the second roller pair (15);

the first roller pair (11) arranged along the upstream path (A) and adapted for transporting the sheets (P,P1,P2) from an upstream side to the reversing means (51);

rotation control means (8) for controlling the reversing roller (13) to rotate in a forward direction at least until each sheet (P,P1,P2) is transported to the second roller pair (15) from the inverting path means (52);

monitor means (SW1, SW2,10) for monitoring the positions of the sheets (P,P1,P2) being transported; and

control means (1) for holding the contact member in the spaced position at least while the monitor means (SW1, SW2) detects that a preceding sheet (P1) and a following sheet (P2) being transported overlap each at the position of the reversing roller (13).

3. A sheet inverting device as defined in claim 2 wherein the control means (1) causes the contact member (131) to move to the contact position at least after the reversing roller (13) is driven in the forward direction by the rotation control means (8) following the arrival of a trailing edge of the preceding sheet (P1) at the reversing roller (13).
4. A sheet inverting device as defined in claim 2 or 3 wherein the control means (1) holds the contact member (131) in the contact position until a leading edge of the following sheet (P2) carried into the inverting path means (52) reaches the reversing means (51) at least after the reversing roller (13) is driven in the forward direction by the rotation control means (8).
5. A sheet inverting device as defined in any of claims 2 to 4 wherein the control means (1) causes the contact member (131) to move to the contact position at the same time when rotation of the reversing roller (13) is changed to the forward rotation.
6. A sheet inverting device as defined in any of claims 2 to 5 wherein the control means (1) holds the contact member (131) in the contact position during a period which lasts until a leading edge of the following sheet (P2) carried into the inverting path means (52) reaches the reversing roller (13) following arrival of a trailing edge of the preceding sheet (P1) carried out of the inverting path at the reversing roller (13) and at least after the reversing roller (13) is driven in the forward direction by the rotation control means (8).
7. A sheet inverting device as defined in any of claims 2 to 6 wherein the first roller pair (11) is spaced apart from the reversing means (51) by a distance at least longer than the length of the sheets (P1,P2) to be transported, and wherein the control means (1) causes the contact member (131) to move to the contact position upon confirming that a trailing edge of the following sheet (P2) carried into the inverting path has passed the first roller pair (11).
8. A sheet inverting device as defined in any of claims 2 to 7 wherein the control means (1) holds the contact member (131) in the spaced position during a period which lasts until a leading edge of the following sheet (P2) carried into the inverting path means (52) reaches the reversing means (51) after a leading edge of the preceding sheet (P1) carried out of the inverting path means (52) reaches the second

roller pair (15).

9. A sheet inverting device as defined in any of claims 2 to 8 wherein the control means (1) cause the contact member (131) to move to the spaced position at the same time when the rotation of the reversing roller (13) is changed to the forward rotation by the rotation control means (8) and holds the contact member (131) in the spaced position during a period which lasts until a leading edge of the following sheet (P2) carried into the inverting path means (52) reaches the reversing means (51) after a leading edge of the preceding sheet (P1) carried out of the inverting path means (52) reaches the second roller pair (15).
10. A sheet inverting device as defined in claims 2 to 9 wherein the monitor means (SW1,SW2,10) includes timer means (10) for measuring predetermined periods and detects the position of the sheets (P1,P2) being transported relative to the first roller pair (11), the inverting path, and the second roller pair (15) by measuring the predetermined periods.
11. A sheet inverting device as defined in any of claims 2 to 10 wherein the monitor means (SW1,SW2,10) includes a first monitor device (SW1) for monitoring the position of the following sheet (P2) carried into the inverting path means (52) based on the passing of a trailing edge of the following sheet (P2) over the first roller pair (11), and a second monitor device (SW2) for monitoring the position of the preceding sheet (P1) carried out of the inverting path means (52) based on the passing of a leading edge of the preceding sheet (P1) over the second roller pair (15).
12. A sheet inverting device as defined in claim 11 wherein the first monitor device is a detector switch (SW1) provided between the first roller pair (11) and the inverting path means (52).
13. A sheet inverting device as defined in claim 11 or 12 wherein the second monitor device is a detector switch (SW2) provided between the inverting path means (52) and the second roller pair (15).
14. A sheet inverting device as defined in claim 1 wherein a third roller pair (12) for transporting sheets from the upstream path (A) includes a drive roller and a driven roller, a fourth roller pair (14) for transporting sheets to the downstream path (C) includes a drive roller and a driven roller, and the third and fourth roller

pairs (12, 14) use the same drive roller in common.

15. A sheet inverting device as defined in any of claims 1 to 15 wherein the contact member is an idle roller (131).

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FIG. 1

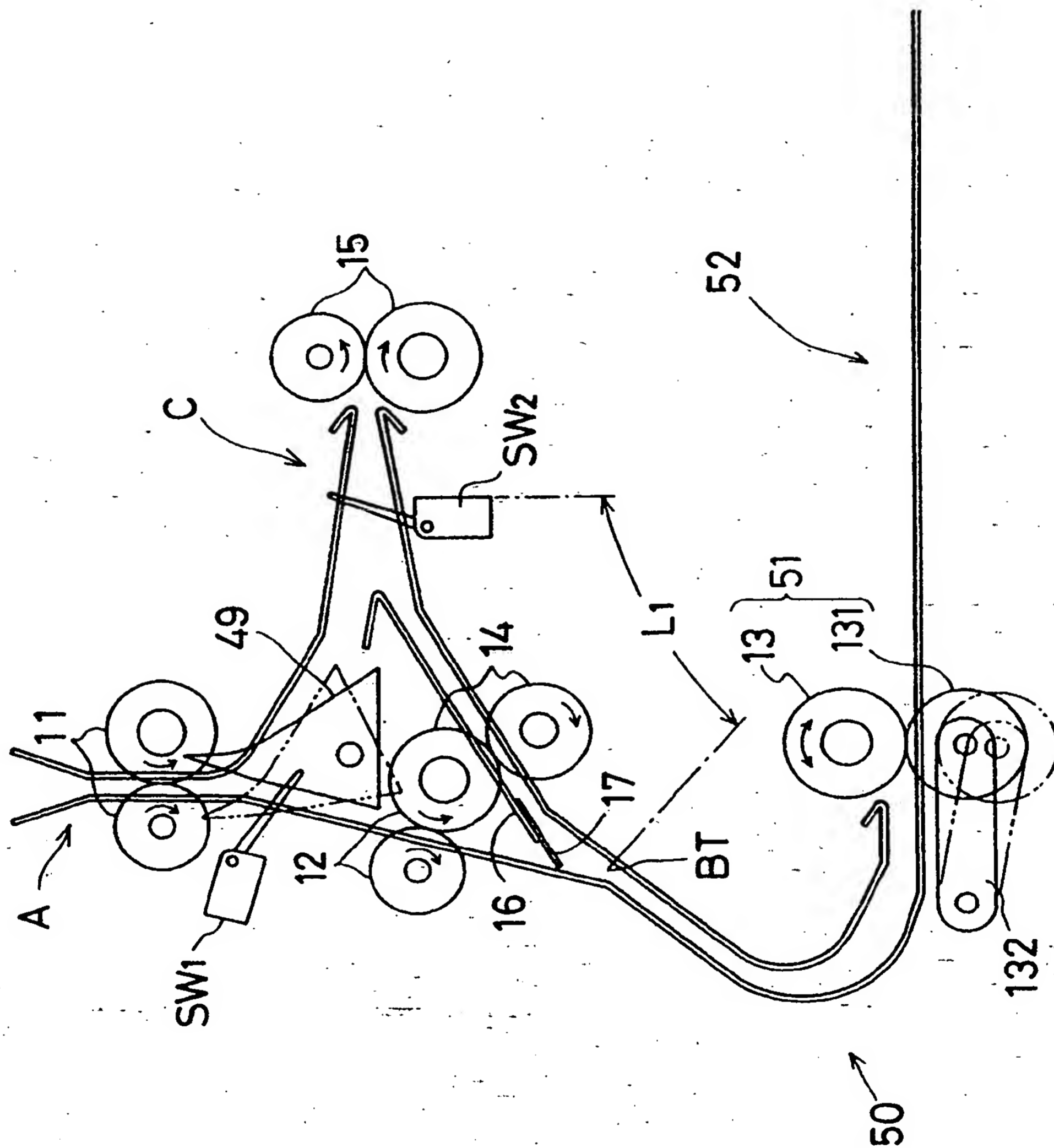


FIG. 2

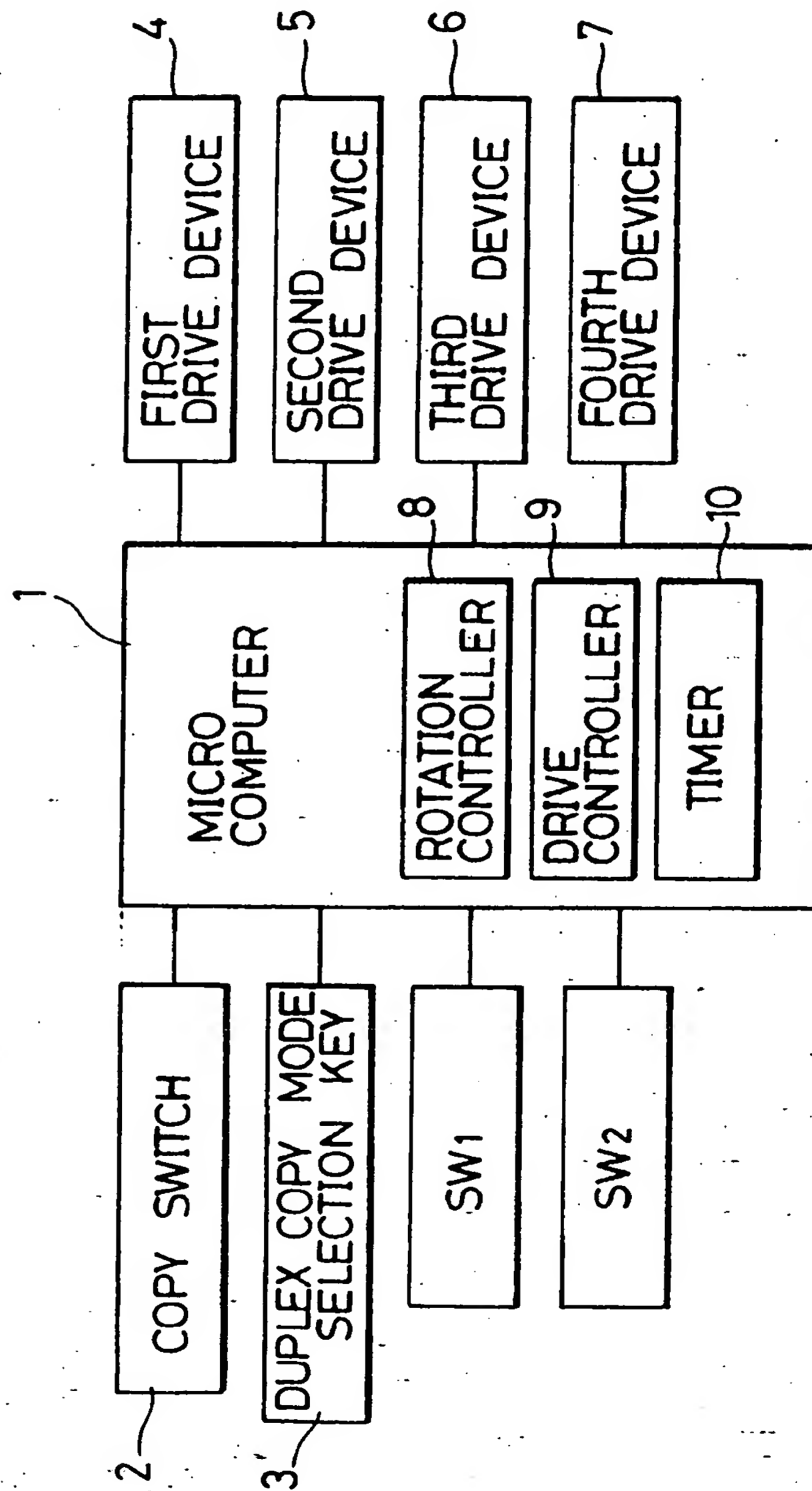


FIG. 3

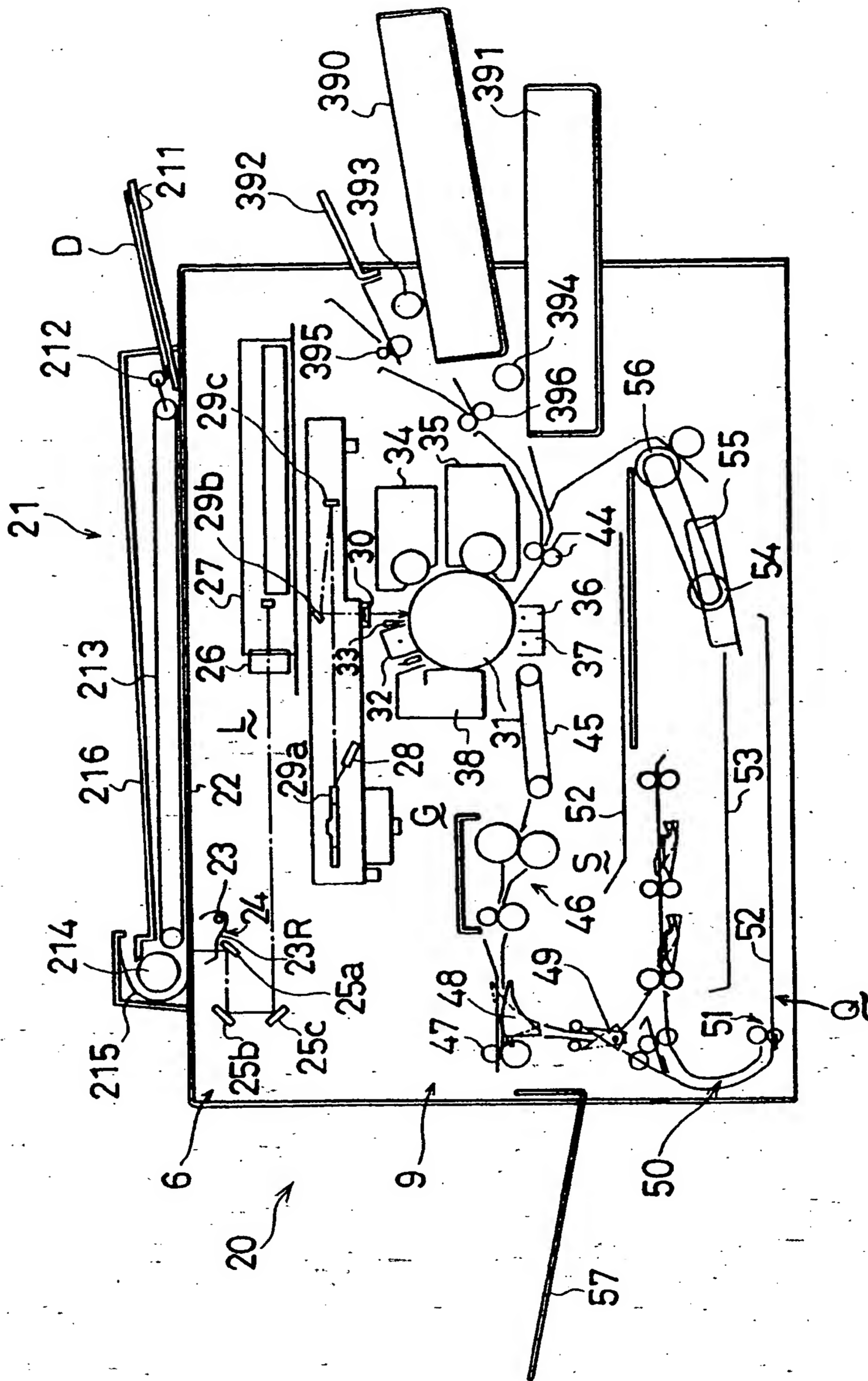


FIG. 4

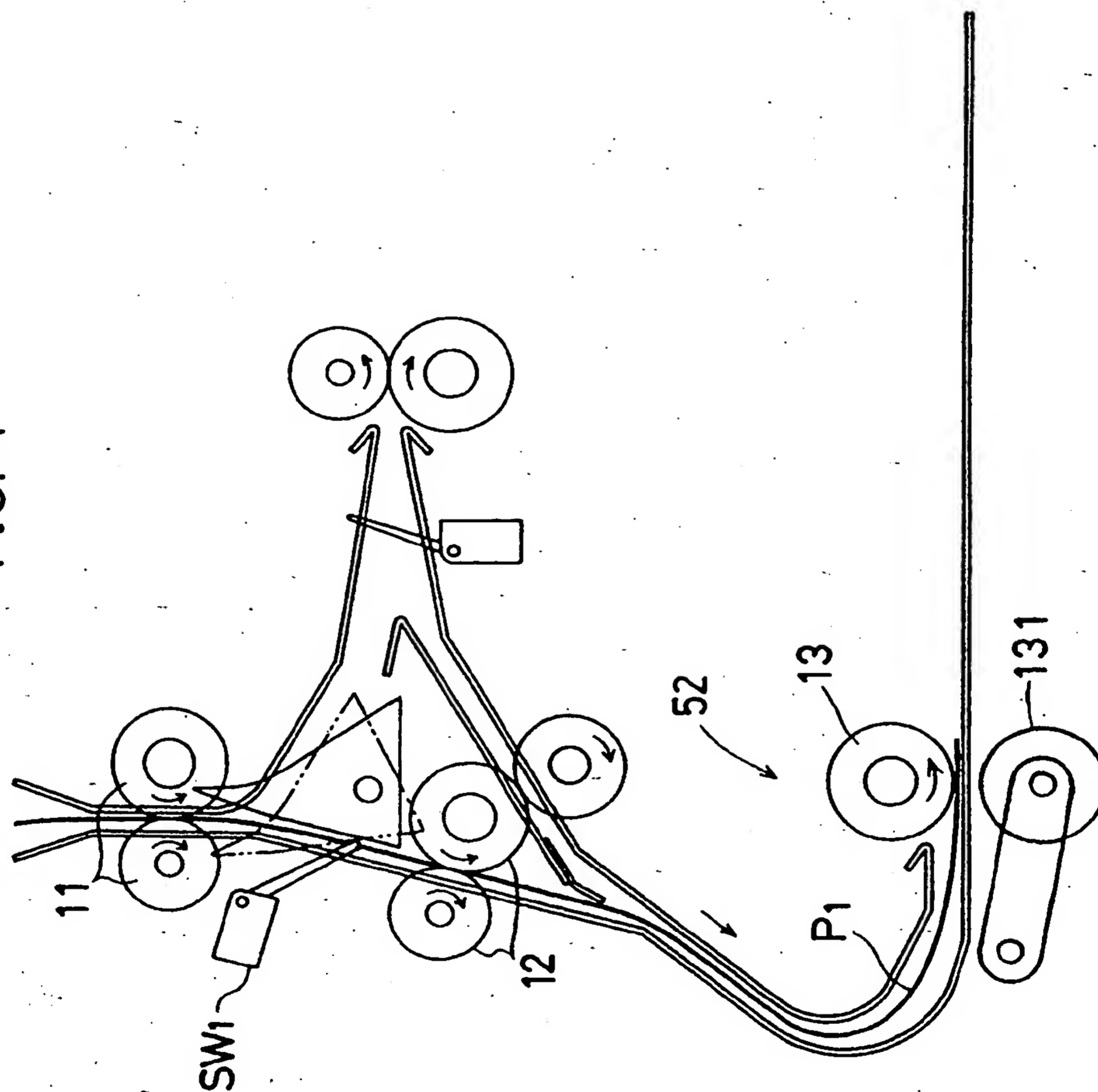


FIG. 5

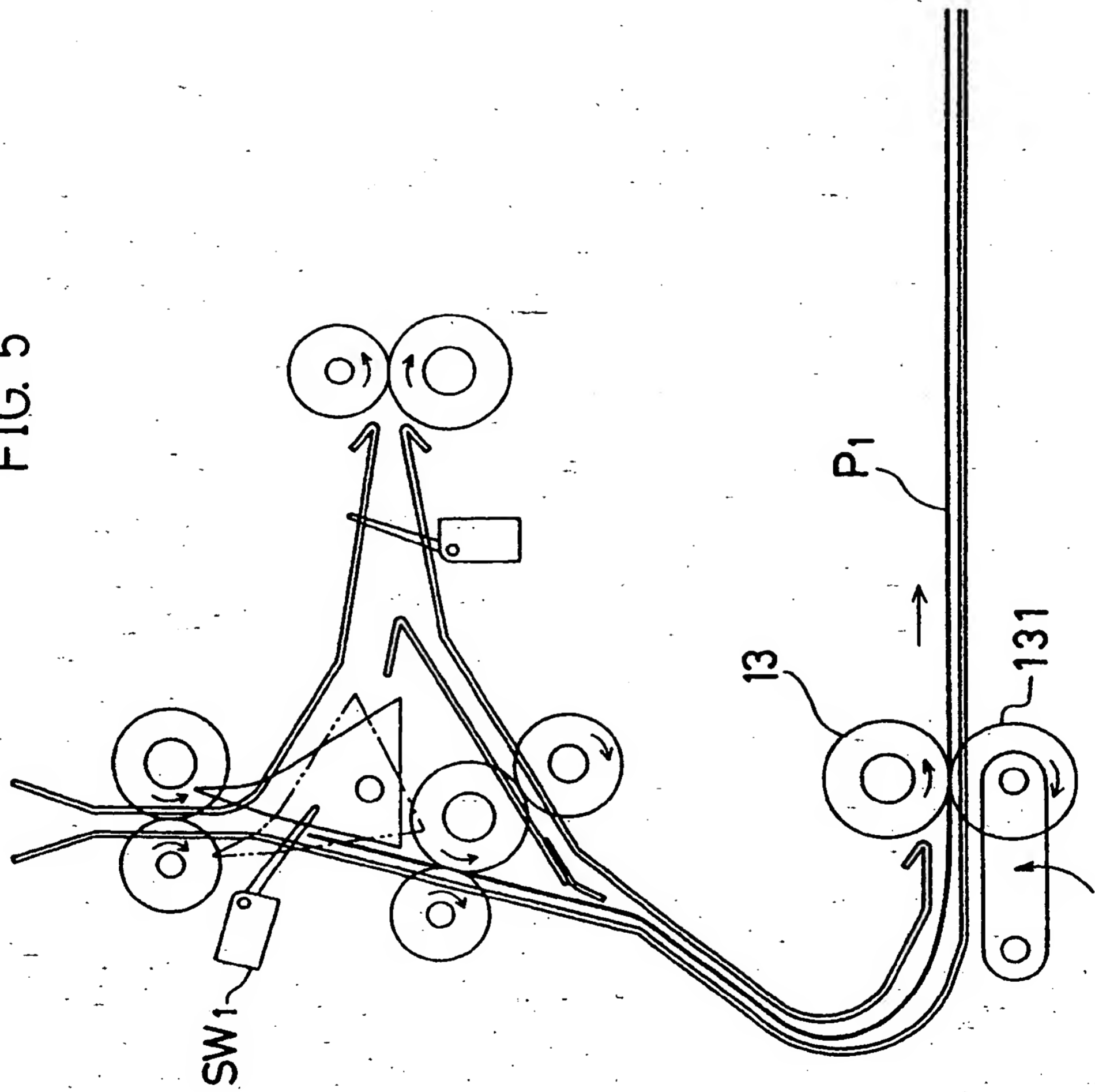


FIG. 6

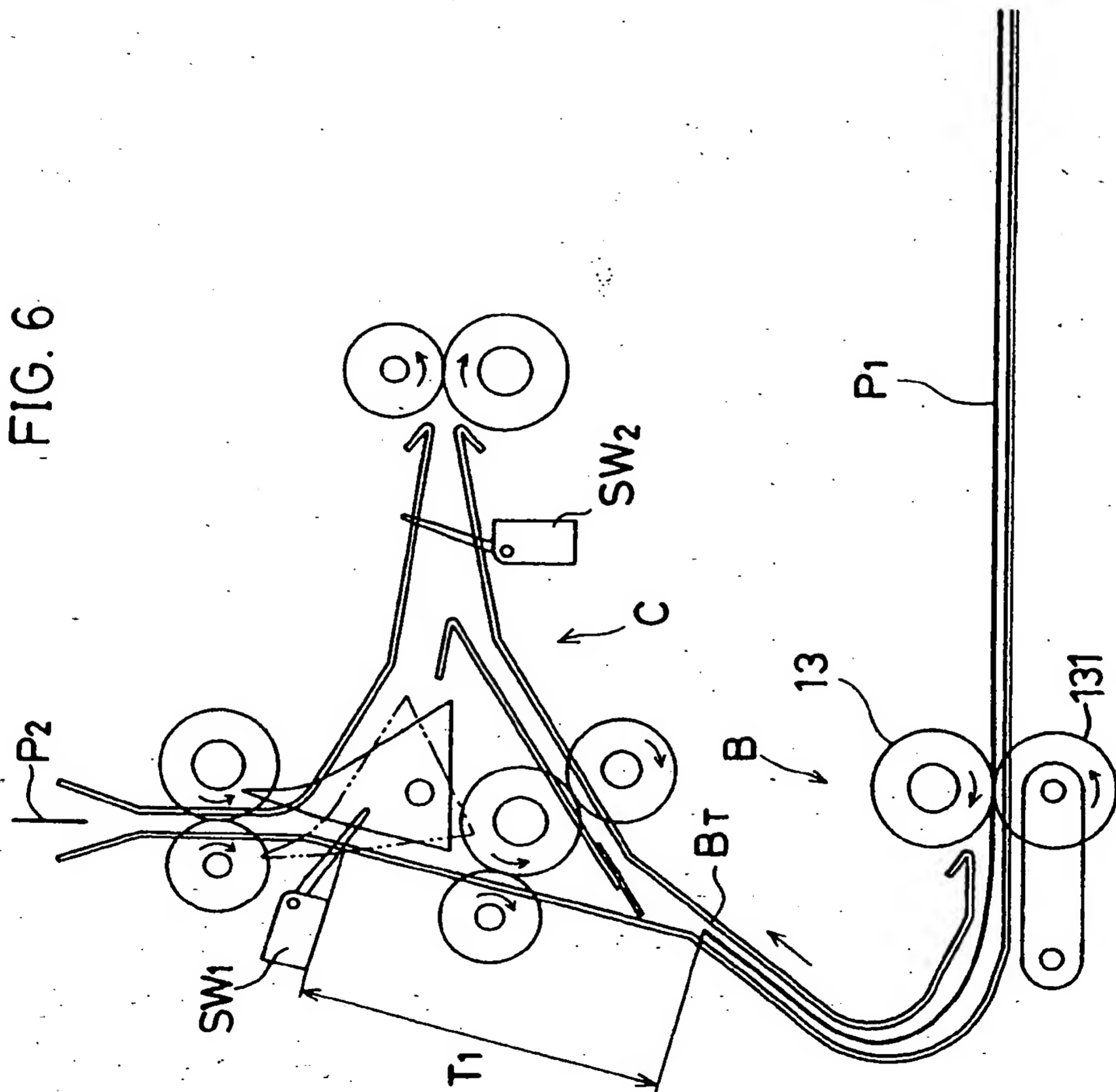


FIG. 7

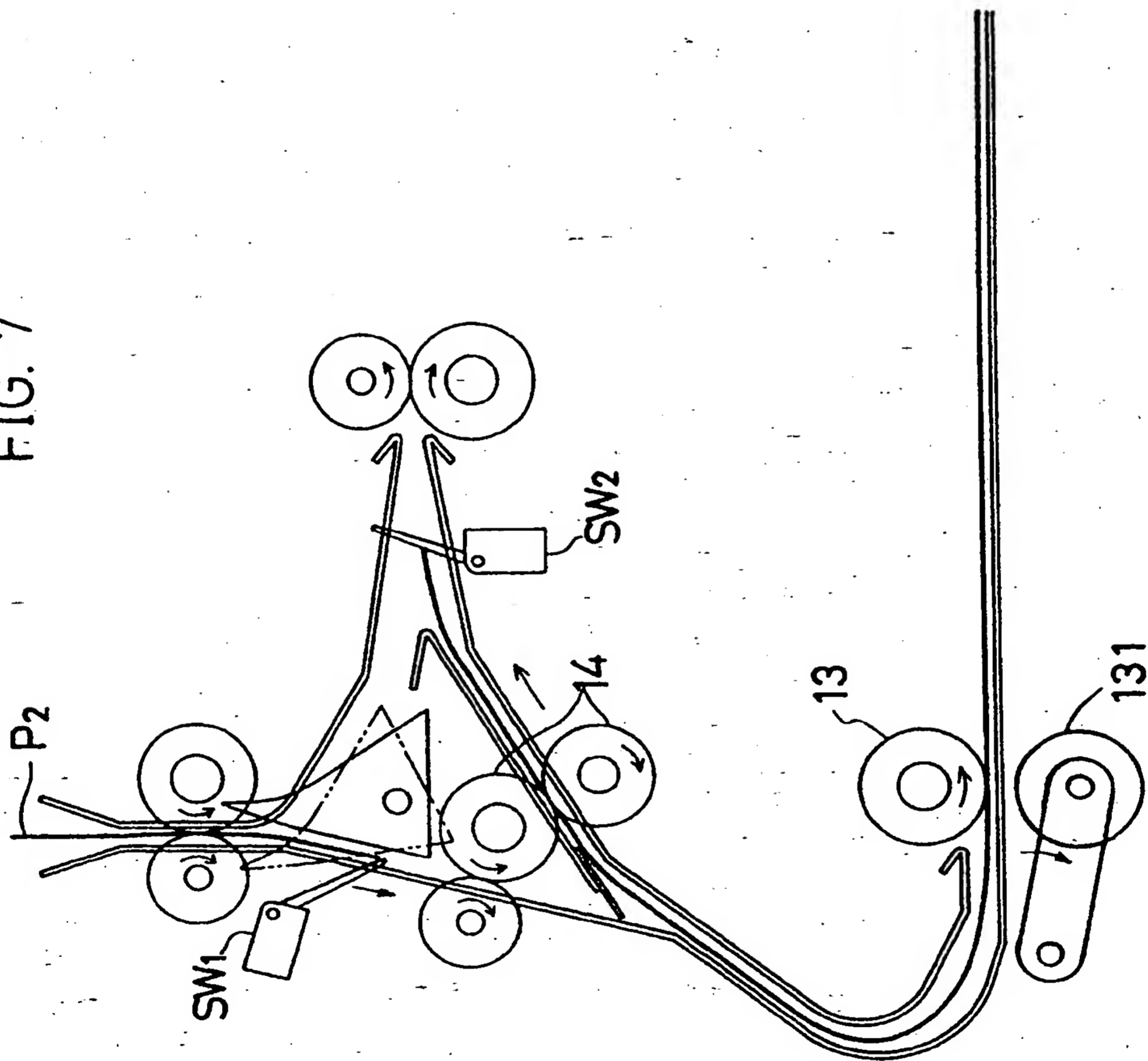


FIG. 8

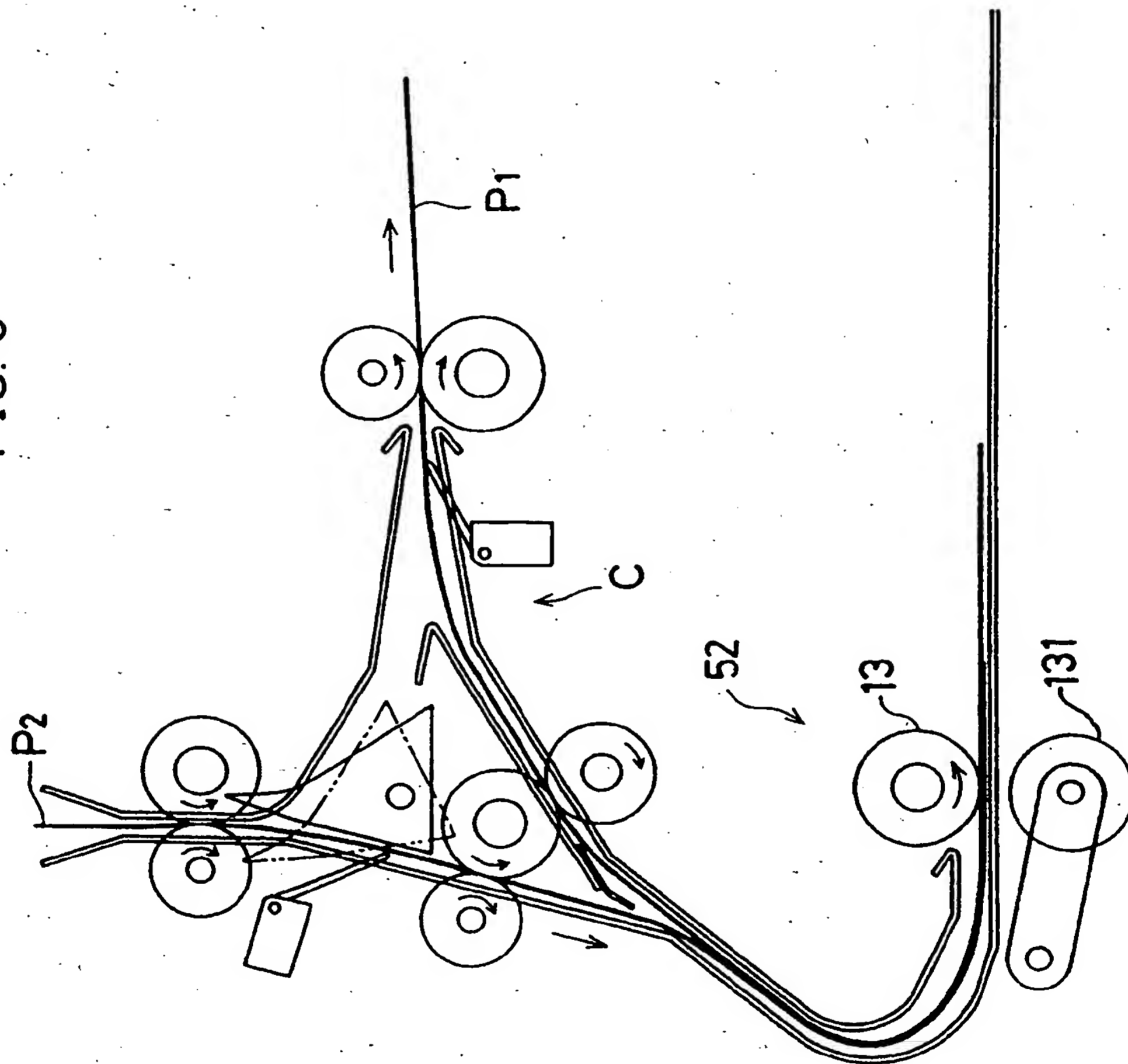


FIG. 9

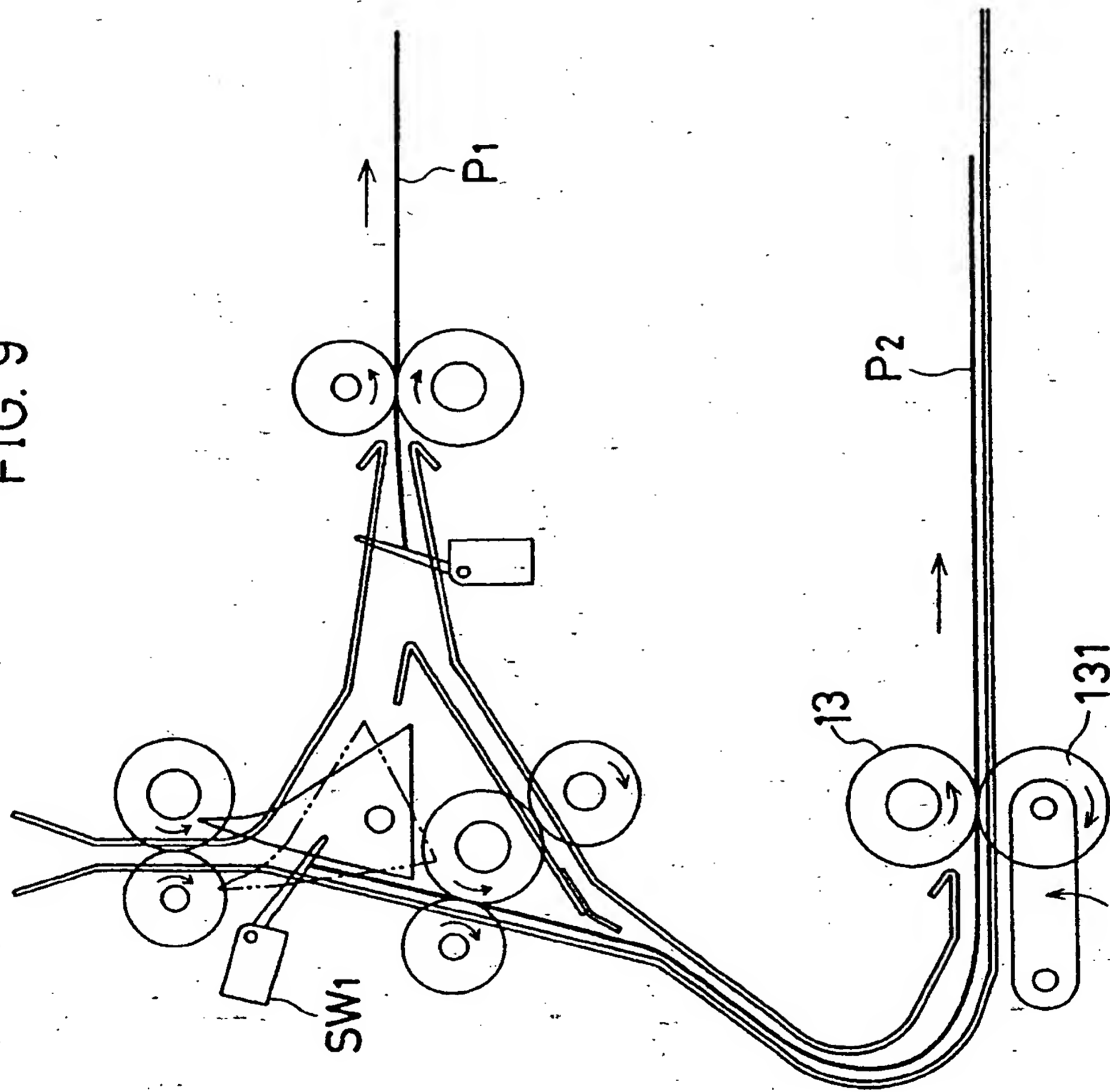


FIG. 10

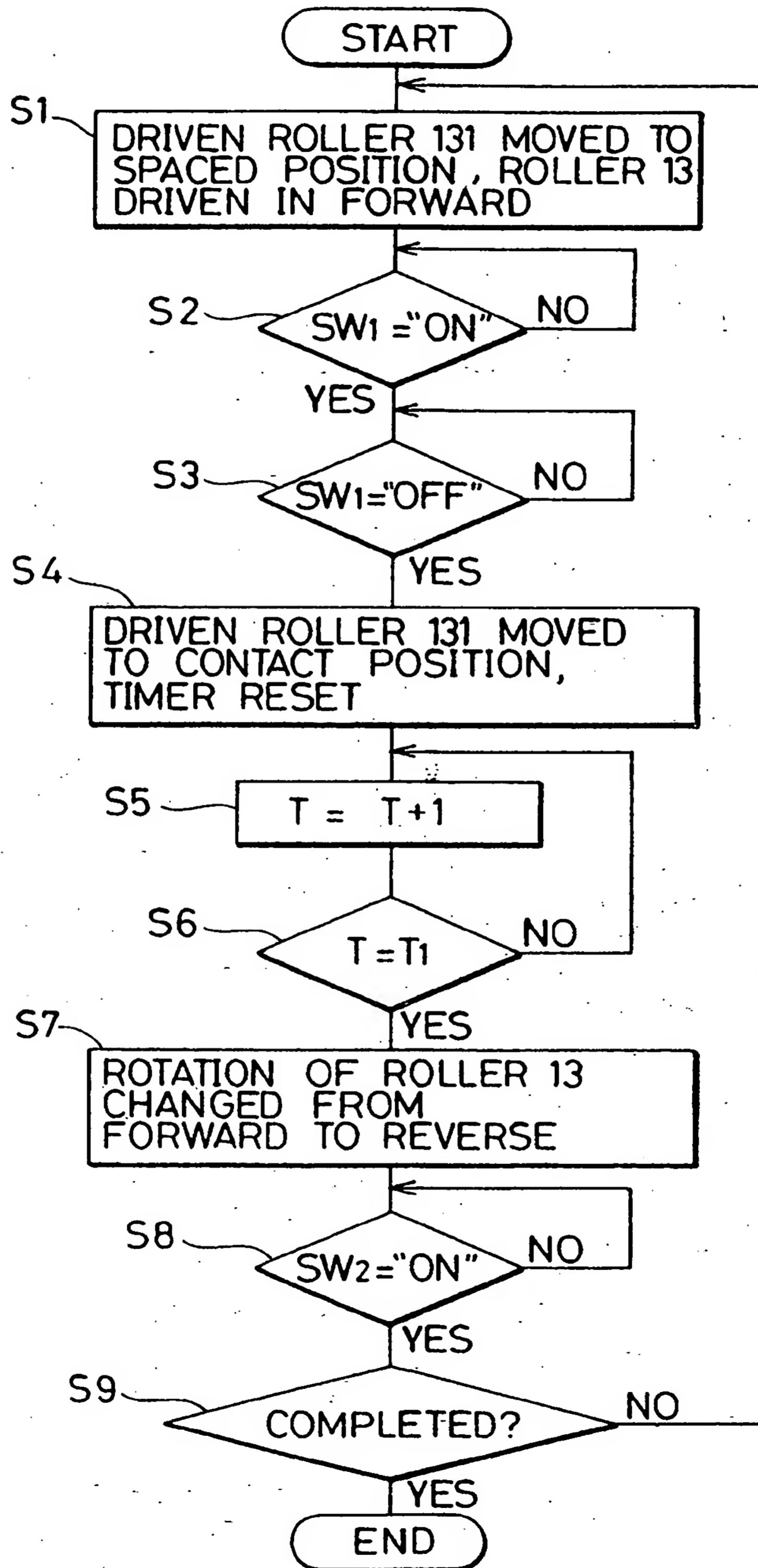
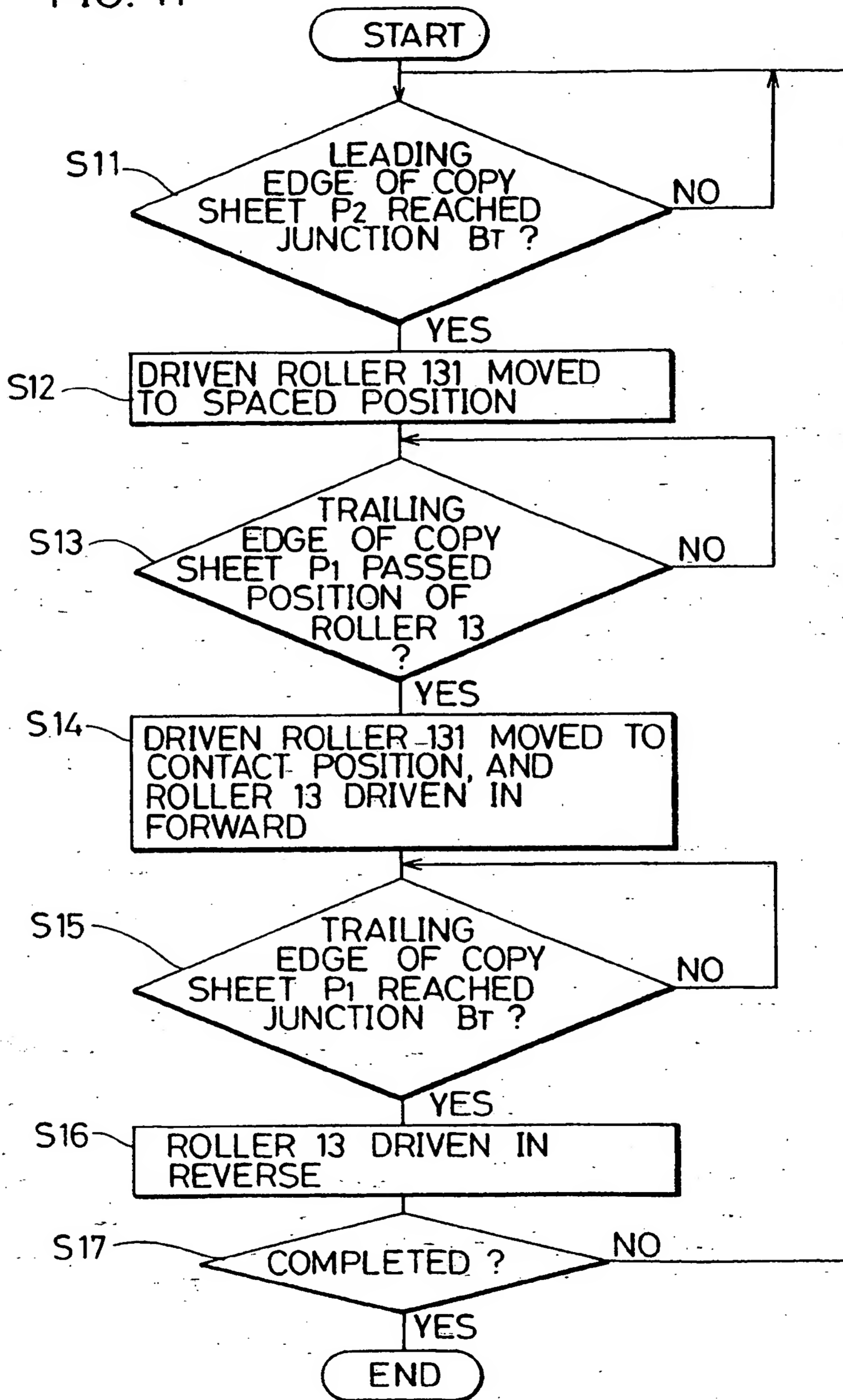
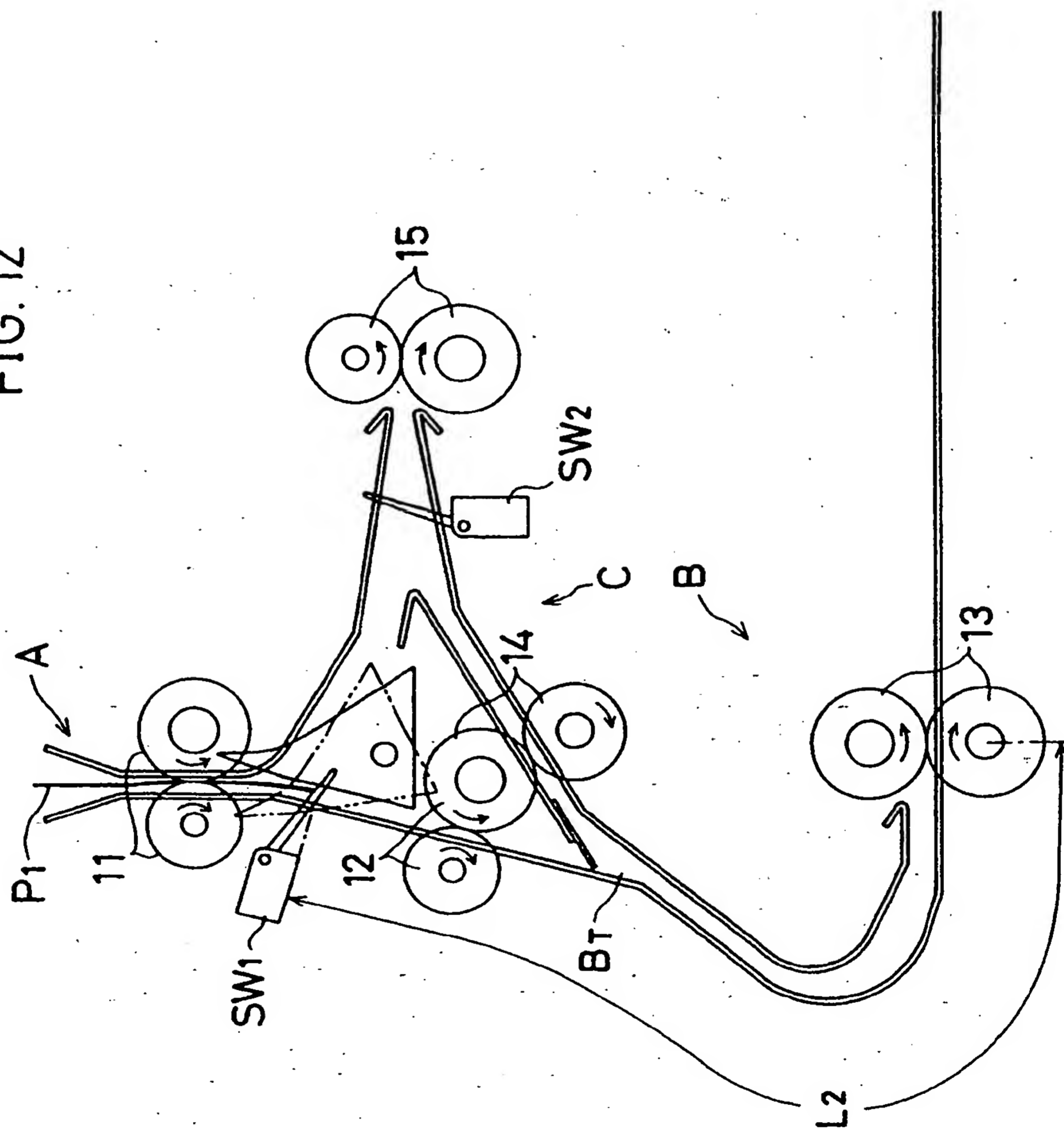


FIG. 11

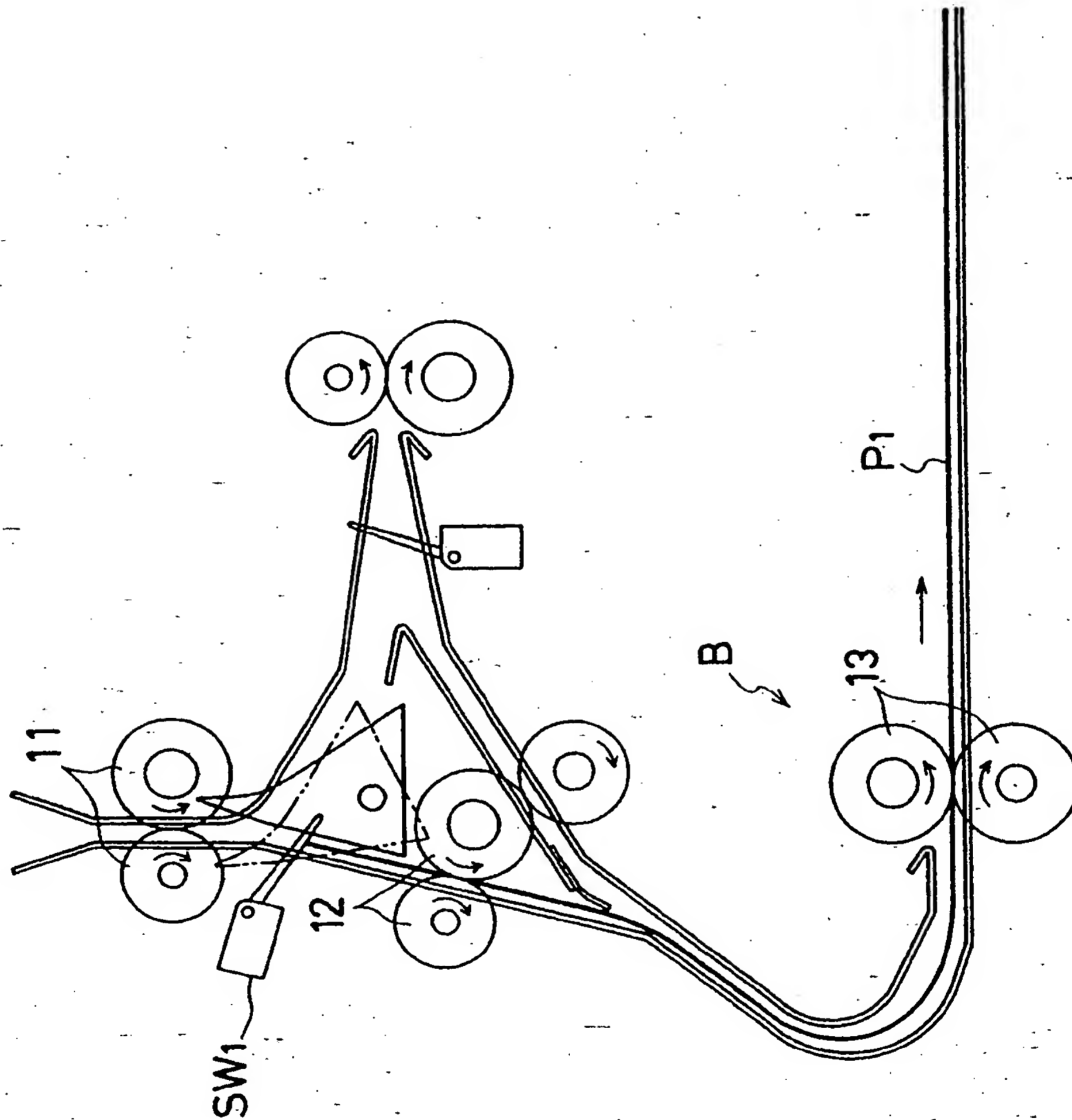


PRIOR ART

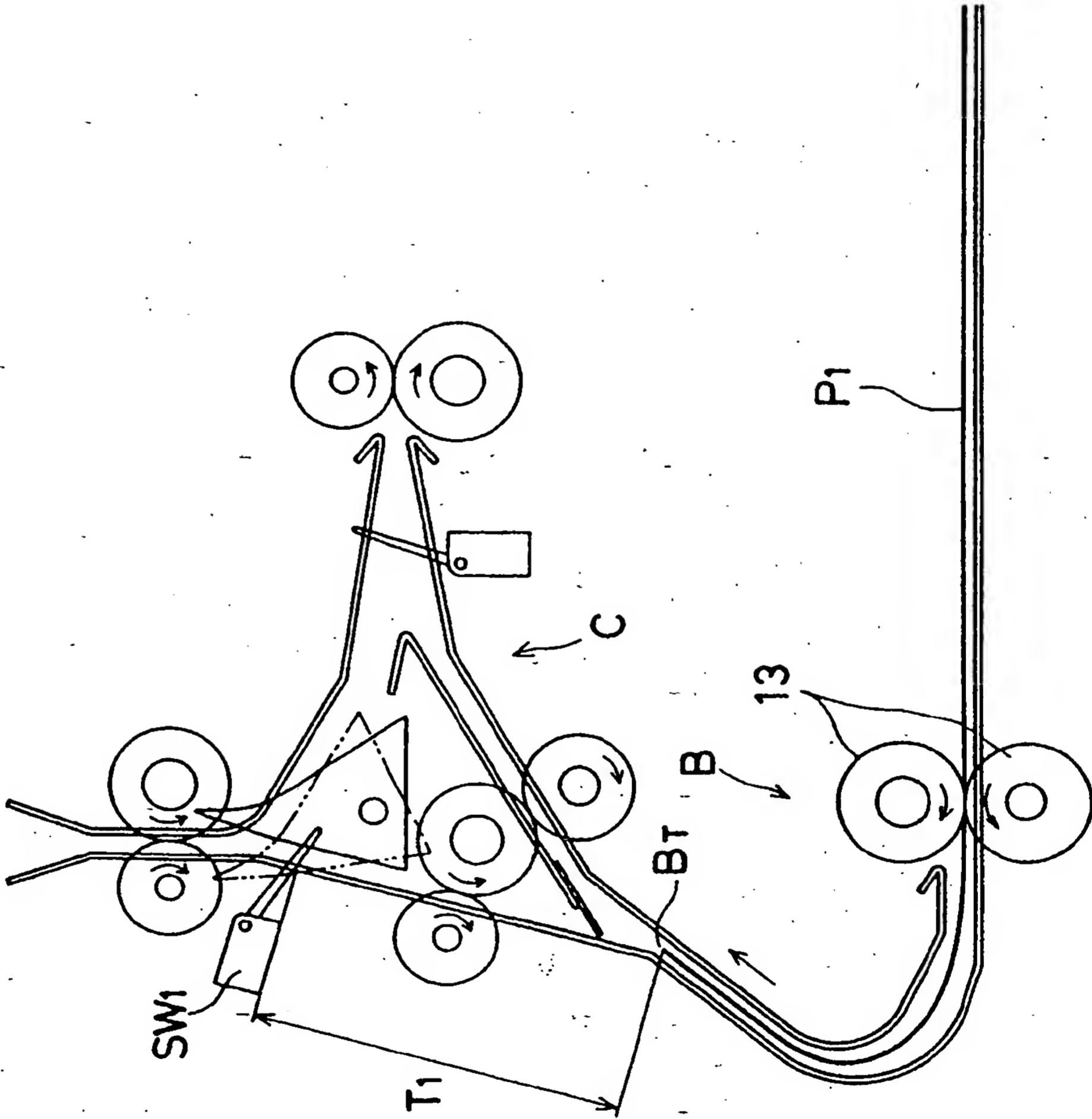
FIG. 12



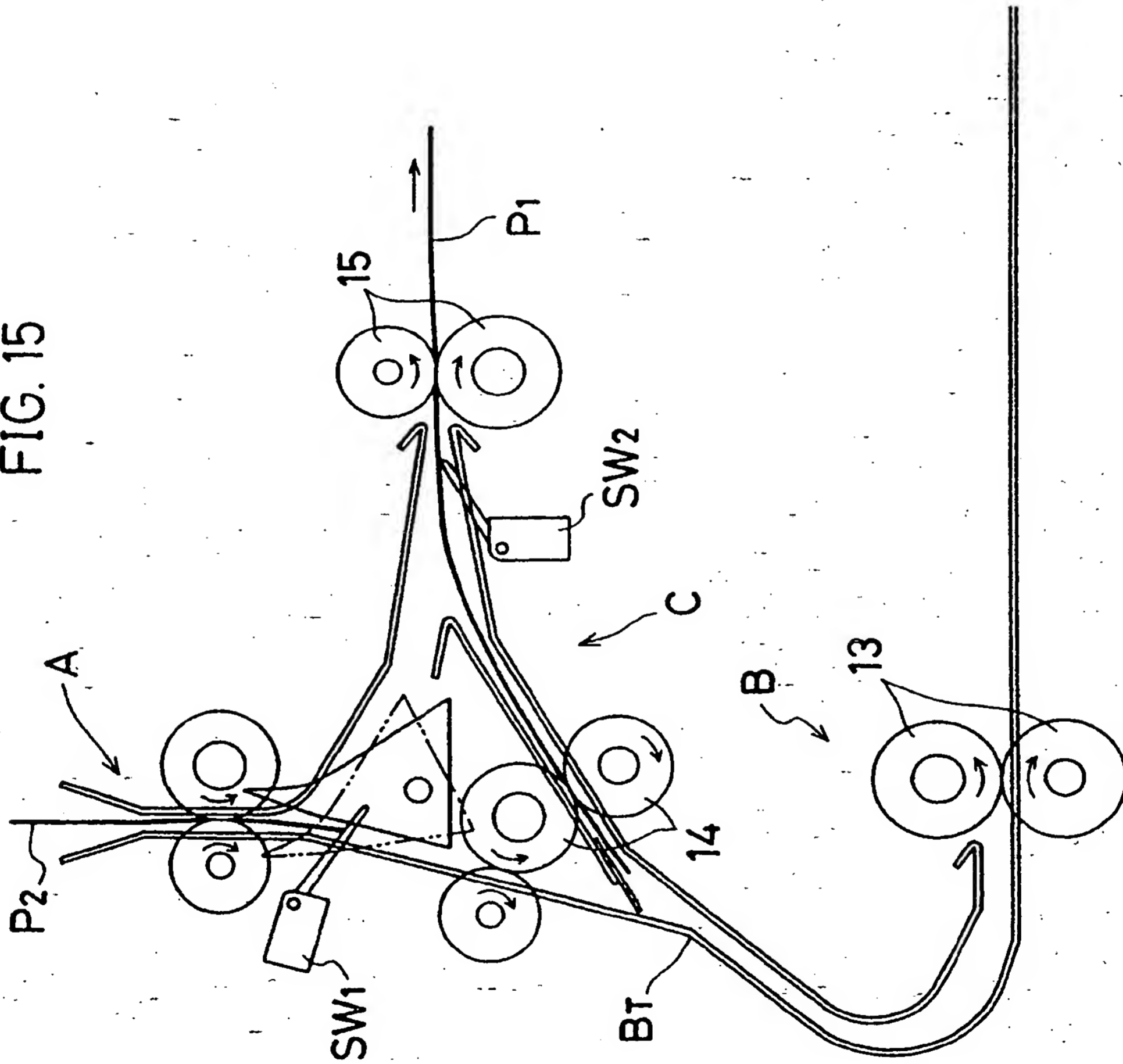
PRIOR ART  
FIG. 13



PRIOR ART  
FIG. 14



PRIOR ART  
FIG. 15





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## EUROPEAN SEARCH REPORT

Application Number

EP 92 11 7303

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	PATENT ABSTRACTS OF JAPAN vol. 11, no. 347 (M-641)13 November 1987 & JP-A-62 126 077 ( SASAKI HIROSHI ) 8 June 1987 * abstract *	1	B65H15/00
X	US-A-4 692 020 (RICOH) * column 2, line 66 - column 3, line 66; figures 1,2 *	1	
X	EP-A-0 391 548 (LEVI STRAUSS) * column 5, line 18 - column 7, line 38; figures 14-26 *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B65H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 06 JANUARY 1993	Examiner LONCKE J.W.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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